CLAIMS

1. A method of determining the instantaneous amplitude (a) and phase (φ) of a sinusoid comprising:

A. digitizing said sinusoid to form a first signal which is the in-phase component (I) of said sinusoid;

B. introducing a phase shift into said digitized sinusoid to produce the quadrature component (Q) of said sinusoid;

C. processing said in-phase and quadrature components to compute the instantaneous phase (φ) of said sinusoid; and

D. processing said in-phase and quadrature components to compute the instantaneous amplitude (a) of said sinusoid.

2. The method of claim 1 further comprising filtering said sinusoid before step B.

3. The method of claim 1 wherein step B further includes introducing a predetermined delay into said quadrature component (Q).

4. The method of claim 3 further comprising introducing said predetermined delay into said in-phase component (I) before step C.

5. The method of claim 4 wherein step C comprises processing the in-phase and quadrature signals according to the following equation:

$$\varphi = \tan^{-1}(Q/I).$$

6. The method of claim 1 wherein step C comprises processing the in-phase and quadrature signals according to the following equation:

$$\varphi = \tan^{-1}(Q/I).$$

7. The method of claim 1 wherein step D comprises processing the in-phase and quadrature signals according to the following equation:

$$a = \sqrt{(Q^2 + I^2)}.$$

8. The method of claim 4 wherein step D comprises processing the in-phase and quadrature signals according to the following equation:

$$a = \sqrt{(Q^2 + I^2)}.$$

9. The method of claim 2 wherein said filtering step comprises attenuating out-of-band noise in said sinusoid.

10. The method of claim 8 wherein said sinusoid is an output of a vibratory sensor.

11. The method of claim 10 wherein said vibratory sensor is an accelerometer.

12. A system for determining the instantaneous phase and amplitude of an analog sinusoid comprising:

a sensor which produces said analog sinusoid output in response to the measurement of a parameter;

an analog-to-digital converter which receives said analog sinusoid from the sensor and converts said analog sinusoid to a digital sinusoid which represents the in-phase component (I) of said sinusoid;

a phase shift device which receives said digital sinusoid and produces the quadrature component (Q) of said digital sinusoid by introducing a phase shift to said digital sinusoid;

an amplitude computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous amplitude (a) of said digital sinusoid; and

a phase computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous phase (φ) of said digital sinusoid.

13. The system of claim 12 further comprising a filter device which receives said digital sinusoid from said analog-to-digital converter and removes out-of-band noise in said digital sinusoid before passing said digital sinusoid to said phase shift device.

14. The system of claim 13 wherein said phase shift device produces said quadrature signal (Q) by introducing a -90 degree phase shift into said digital sinusoid.

15. The system of claim 14 wherein said phase shift device further introduces a predetermined delay into said quadrature component (Q).

16. The system of claim 15 further comprising a delay device which introduces said predetermined delay into said in-phase component (I).

17. The system of claim 15 wherein said phase shift device comprises a Hilbert transformer approximation device.

18. The system of claim 16 wherein said amplitude computation device computes the instantaneous amplitude (a) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) signals according to the equation $a = \sqrt{(Q^2 + I^2)}$.

19. The system of claim 18 wherein said phase computation device computes the instantaneous phase (φ) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) signals according to the equation $\varphi = \tan^{-1}(Q/I)$.

20. The system of claim 12 wherein said amplitude computation device computes the instantaneous amplitude (a) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) signals according to the CORDIC algorithm.

21. The system of claim 16 wherein said phase computation device computes the instantaneous phase (φ) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) signals according to the CORDIC algorithm.

22. The system of claim 16 wherein said sensor comprises a vibratory accelerometer.

23. The system of claim 16 wherein said sensor comprises one of an accelerometer, a gyroscope, a microphone, a vibration sensor and a chemical sensor.

24. A system for determining the instantaneous amplitude (a) and phase (φ) of an analog sinusoid comprising:

a sensor which produces said analog sinusoid output in response to the measurement of a parameter;

an analog-to-digital converter which receives said analog sinusoid from the sensor and converts said analog sinusoid to a digital sinusoid to form the in-phase component (I) of said sinusoid;

a Hilbert transformer approximation device which receives said digital sinusoid and produces the quadrature component (Q) of said digital sinusoid by introducing a phase shift to said digital sinusoid;

an amplitude computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous amplitude (a) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) components according to the equation $a = \sqrt{(Q^2 + I^2)}$; and

a phase computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous phase (φ) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) components according to the equation $\varphi = \tan^{-1}(Q/I)$.

25. The system of claim 24 wherein said Hilbert transformer approximation device further introduces a predetermined delay into said quadrature component (Q).

26. The system of claim 25 further comprising a delay device which introduces said predetermined delay into said in-phase component (I).

27. A system for determining the instantaneous amplitude and phase of an analog sinusoid comprising:

a sensor which produces said analog sinusoid output in response to the measurement of a parameter;

an analog-to-digital converter which receives said analog sinusoid from the sensor and converts said analog sinusoid to a digital sinusoid sinusoid to form the in-phase component (I) of said sinusoid;

a Hilbert transformer approximation device which receives said digital sinusoid and produces the quadrature component (Q) of said digital sinusoid by introducing a phase shift to said digital sinusoid;

an amplitude computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous amplitude (a) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) components according to the CORDIC algorithm; and

a phase computation device which receives said in-phase (I) and quadrature (Q) components and computes the instantaneous phase (φ) of said digital sinusoid by processing said in-phase (I) and quadrature (Q) components according to the CORDIC algorithm.

28. The system of claim 27 wherein said Hilbert transformer approximation device further introduces a predetermined delay into said quadrature component (Q).

29. The system of claim 28 further comprising a delay device which introduces said predetermined delay into said in-phase component (I).

30. The system of claim 29 wherein said sensor comprises one of an accelerometer, a gyroscope, a microphone, a vibration sensor and a chemical sensor.

31. A method of determining the amplitude (a) and phase (φ) of a sinusoid comprising:

A. measuring a parameter with a sensor;

B. generating an analog sinusoid representative of said parameter;

C. digitizing said analog sinusoid to produce a digital sinusoid;

D. filtering said digital sinusoid to attenuate out-of-band noise in said digital sinusoid;

E. producing an in-phase signal (I) associated with said digital sinusoid;

F. introducing a phase shift into said digital sinusoid to produce a quadrature signal (Q) associated with said digital sinusoid;

G. processing said in-phase (I) and quadrature (Q) signals to compute said amplitude (a) of said digital sinusoid by applying the equation $a = \sqrt{(Q^2 + I^2)}$; and

H. processing said in-phase (I) and quadrature (Q) signals to compute said phase (φ) of said digital sinusoid by applying the equation $\varphi = \tan^{-1}(Q/I)$.

32. The method of claim 31 wherein step F includes introducing a predetermined delay into said digital sinusoid.

33. The method of claim 32 further comprising introducing said predetermined delay into said in-phase signal (I) prior to step G.

34. The method of claim 32 wherein, in step F, said phase shift is equal to -90 degrees.

35. The method of claim 34 wherein said sensor comprises one of an accelerometer, a gyroscope, a microphone, a vibration sensor and a chemical sensor.

36. A method of determining the amplitude (a) and phase (φ) of a sinusoid comprising:

A. measuring a parameter of an object with a sensor;

B. generating an analog sinusoid representative of said parameter;

C. digitizing said analog sinusoid to produce a digital sinusoid;

D. filtering said digital sinusoid to attenuate out-of-band noise in said digital sinusoid;

E. introducing a delay into said digital sinusoid to produce an in-phase signal (I) associated with said digital sinusoid;

F. performing a Hilbert transform approximation of said digital sinusoid to introduce a phase shift plus delay into said digital sinusoid, thereby producing a quadrature signal (Q) associated with said digital sinusoid;

G. processing said in-phase (I) and quadrature (Q) signals to compute said amplitude (a) of said digital sinusoid by applying the equation $a = \sqrt{(Q^2 + I^2)}$; and

H. processing said in-phase (I) and quadrature (Q) signals to compute said phase (φ) of said digital sinusoid by applying the equation $\varphi = \tan^{-1}(Q/I)$.

37. The method of claim 36 wherein said sensor comprises one of an accelerometer, a gyroscope, a microphone, a vibration sensor and a chemical sensor.

38. A method of determining the amplitude (a) and phase (φ) of a sinusoid comprising:

A. measuring a parameter of an object with a sensor;

B. generating an analog sinusoid representative of said parameter;

C. digitizing said analog sinusoid to produce a digital sinusoid;

D. filtering said digital sinusoid to attenuate out-of-band noise in said digital sinusoid;

E. producing an in-phase signal (I) associated with said digital sinusoid;

F. introducing a phase shift into said digital sinusoid, thereby producing a quadrature signal (Q) associated with said digital sinusoid;

G. processing said in-phase (I) and quadrature (Q) signals to compute said amplitude (a) of said digital sinusoid according to the CORDIC algorithm; and

H. processing said in-phase (I) and quadrature (Q) signals to compute said phase (φ) of said digital sinusoid according to the CORDIC algorithm.

39. The method of claim 38 wherein step F includes introducing a predetermined delay into said digital sinusoid.

40. The method of claim 29 further comprising introducing said predetermined delay into said in-phase signal prior to step G.